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Research and enhancement of used tyres, such as material innovative in Algeria

F. BELABDELOUAHAB[a], H. TROUZINE[b]

[a] Doctor, Lecturer in ENSTP - National School of Public Works - Kouba –Algiers 16051- Algeria

[b] Doctor, Department of Civil Engineering, Faculty of Engineering Sciences University Djillali Liabes, Sidi Bel Abbes - Algeria

Abstract

Currently engineers seeking to improve the characteristics of soils used for the construction of earthworks, with innovations developed from ideas, products or processes of original construction, the land army is an early example particularly successful but there are many other processes as well as other Pneusol processes more or less known to sometimes use bulky industrial wastes, while fitting well into the existing environment. In this paper, we discuss a particular research work within the framework of environmental protection and sustainable development, led to the realization of the recovery and reuse of used tires in the construction of works civil engineering.

The main objective of this paper is to present the results of studies in Algiers on ENSTP " Pneusol reducing the thrust" on a scale model on the study of a retaining wall reinforced by a simulation tablecloths tires, and the results of particular research enterprise at the University Djillali Liabes of Sidi Bel Abbes, on an experimental campaign on the Pneusol under expansive soil foundations.

Topics will also present the projects carried out in Algeria, as the pilot of stability of a slope to Pneusol in Bousmail (2005), then another item of protection against landslides in Bejaia (2006), from the project of Africa in Mostaganem (2007), concerning the stability of an embankment on the RN11 road, and the conduct of a small dike protection technology Pneusol in Blida (2008), and in 2010 the stability of a landslide in Miliana.

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***Keywords*:** environment; used tyres; tyresoil; retaining; pneusol; reducing of push; stability.

* Corresponding author. Tel.: +00 213 5 55 37 38 11

E-mail address: belabdelouahabf@yahoo.fr

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1. Introduction

If we exclude the risk of fire, the scrap tire is not a real danger to the environment. However, the ever growing mass of waste, the low degradation rate and compressibility are many disadvantages to their burial.

Used tires at the end of life are now a valuable resource to 100% with increasing numbers of outlets. Various ways specific recovery is possible. Even used, the material of the tire retains many qualities: strength, solidity of structure, high calorific value, high-carbon, and sustainability ... All these qualities make a raw material used tire highly recoverable, used in many applications.

Through the technique Pneusol, what formed the Association of tires (truck or passenger) whole, partially cut (removal of a side) or completely cut (removal of two sides) with natural soils or artificial (expanded clay, for example, or others), or slightly cohesive powders, or other refuse (mâchefers. ..). It is both a material civil engineering and a form of recovery of scrap tires. The used tire waste is bulky and detrimental to the environment.

With Pneusol, the engineer is required to reuse these waste technically and economically advantageous in a number of areas of civil engineering (soil stability, soil reinforcement, in drainage, energy absorber, dispatcher stress, lightweight fill , guard the banks and bottom of the channels. ... etc..)

Early researches on the material in Algeria have started Pneusol 1989 to date (gear thrust earthquake, expansive soil under foundations, and crumb rubber ...). Note that several projects have been performed with this technique; the following table gives an order of magnitude of projects made with the material Pneusol worldwide. [1] [2]

Table 1. Number of project by country

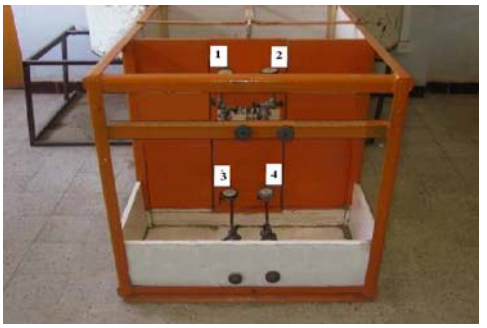
Country	Number of Project
Algeria	20
France	255
Etats Unis	06
Suisse	06
Allemagne	01
Roumania	01
Jordania	01
Brasilia	01
Rwanda	01

2. Research in Algeria on the use of used tires.

Much research has been conducted to study the behavior of Pneusol as innovative material. To this end we mention the most important.

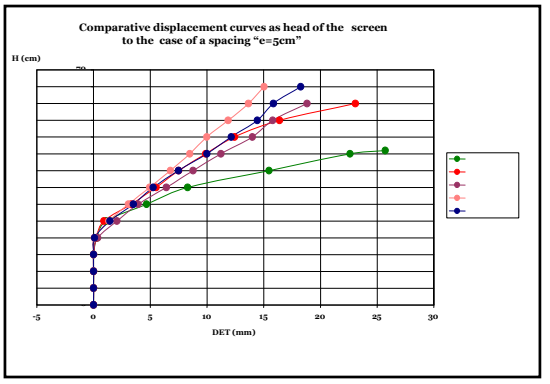
2.1. Pneusol gear thrust

Early research on Pneusol in Algeria began in 1989 in Algiers ENSTP, mainly on the Pneusol "reducer Thrust" today. This research was able to identify several parameters, but mainly a net reduction of 30% of the thrust behind a retaining wall, which is very significant, for the establishment of an inclusion of what the building used tire. The research is based on models designed and manufactured to ENSTP in order to study the various possible applications of Pneusol. [3][4]



1
2
3
4

Fig. 1. Model three-dimensional experimental ENSTP



H	Height of the screen
DET	displacement the top of the screen
(S.S)	Sand Only
(NRL)	Tablecloths longitudinally linked tires
(NRT)	Tablecloth tires attached transversely
(R.L)	longitudinal rows of tires
(R.T)	transverse rows of tires

Fig. 2. Comparative curve by mode "Pneusol gear thrust"

This phase of research done on three-dimensional model based on tests that simulate the presence of Pneusol behind a retaining wall. The study of 'Pneusol gear thrust' aims to highlight the results of a qualitative nature that can highlight the influence of several parameters (layout, spacing, tablecloths, clips...). The tests simulate the presence of Pneusol behind a retaining wall.

2.2. Pneusol earthquake.

From the perspective of use of used tires at the foundation works for the purpose of the reversal of stress due to earthquakes, and the level of the embankments, tests were performed on a different model using mainly a table vibrant, testing an embankment of sand crushed to uniform size (Dmin = 0.08 mm, Dmax = 2 mm) from the coast of Algiers. The internal friction angle is 31 °. The test table of dimension 1 x 1 meter is mounted on a vibrating table. The settlements are measured using comparators mounted on a metal gantry independent amplitudes are measured by a fixed frame of the model.

2.3. Crumb rubber in road pavements.

Currently, research focuses on the study and feasibility for the use of crumb rubber in road pavement, rubberized asphalt"

The goal is to improve the thermal stability and characteristics of road surfaces. One possibility is the incorporation of recycled rubber in asphalt. This method has the advantage of replacing virgin materials: thermoplastic elastomers, natural rubber latex, without sacrificing the quality of the coatings.

Both methods of incorporating recycled rubber are the substitution of a portion of aggregates for asphalt by rubber granules (dry method) and the Wet method. The latter is based on a direct mixing of powder rubber in the asphalt binder and aggregates, seems to be the most suitable.

The composition of a modified bitumen is approximately:

- 80% bitumen
- 18% recycled rubber powder
- 2% of aromatic oil

In general, the presence of rubber in the bitumen does not influence susceptibility to temperature and improves resistance to thermal cracking thereof. In contrast, the permeability decreases slightly compared to the unmodified asphalt but still quite acceptable.

The crumb rubber also plays an important role in the manufacture of coated muffs. The process involves integrating Colsoft crumb coated with tar. The improved performance comes from sound absorption of shock waves of the tire in motion by the rubber particles. A decrease of 4 to 7 dB (A) can be obtained.

Photo.1. Technical 'rubberized asphalt'

2.4. Pneusol under expansive soil foundation.

The research started in the Department of Civil Engineering at the University of Djillali Liabes Sidi Bel Abbes are aimed at studying the possibility of using scrap tires (or Technical Pneusol ADD "tires Derived Aggregate" for the design of soil fluffy.

A laboratory model (Figure 3) was designed and several experimental campaigns were conducted to study this new application. [7]

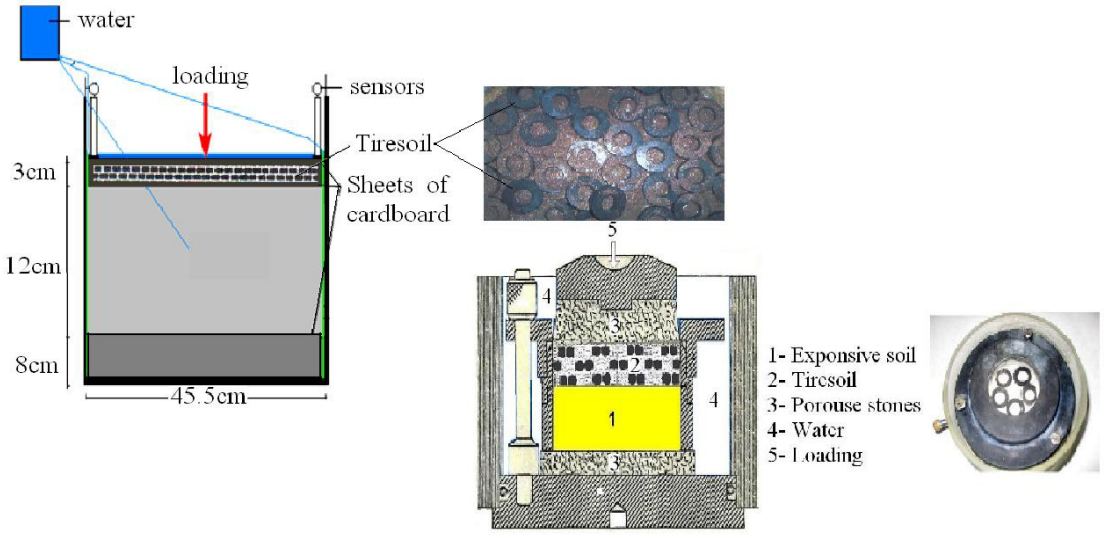


Fig.3. Model Laboratory Materials and Hydrology University Djillali Liabes Sidi Bel Abbes (Trouzine et al 2008)

The various studies on this material showed that its bearing capacity is sufficient to support a lightweight construction and its power of absorption of waves and surges land is remarkable. It is therefore possible to envisage its use as a foundation or foundation layer of small buildings or structures on light soils.

3. Enrichment and Achievement in Algeria by the technique Pneusol

Pneusol several achievements were made in Algeria, we cite in the following achievements and some important projects:

Table 2. Type of project (Algeria)

Type of Project	Project location	Number
Dispatcher of contraints	Ain Temouchent **(1986)**	12 projects
Retaining structure	Temporary retaining wall - Algers Metro **(2002)**	01 project
Slope stability	Building an embankment Bypass City Bousmail Wilaya of Tipaza **(2005)**	01 project
Protection against landslides	Mr OUMEDJBAR -Wilaya of Bejaia **(2006)**	01 project
Slope stability	Modernization RN 11 - Wilaya of Mostaganem **(2007)**	01 project
Dike Protection	Pont de Bou Arfa - Wilaya of Blida **(2008)**	01 project
Stability of a landslide	Miliana - Wilaya of Ain Defla **(2010)**	01 project

• Project of Bousmail [2006]

This project is the first of its kind in Algeria's primary role is to increase the stability of the embankment road running through the project of making the avoidance of Bousmail town in the wilaya of Tipaza and to stiffen its slope and finally ease the burden on the downstream side of a box culvert

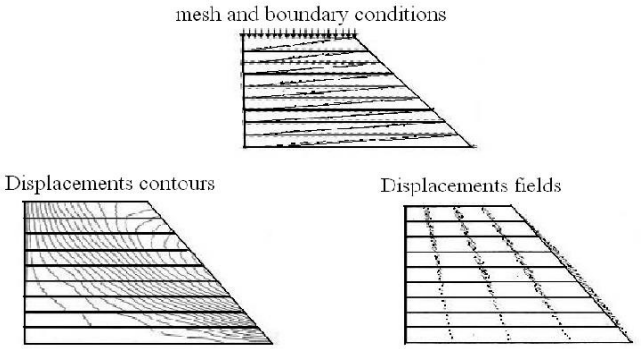


Photo.2. Pilot Project - Route Bousmail

• Project of Tizi Ghenif [2006]

This case is similar to the sliding mass. This is a project produced in Algeria by an individual's own means. The tires supplied by Michelin Algeria truck tires are integers with the two sides (120x60x33)

filling was performed manually, the soil used to backfill "Pneusol" being the same soil existing on site (waste truck tires Michelin 1000).

Photo.3. Stability of a landslide - Project of Tizi Ghenif - Wilaya of Tizi Ouzou, Algeria

- **Project of Mostaganem [2007]**

Regarding the third project, which is the greatest project done in Africa; the project consisted in the realization of a fill light by the technique "Pneusol".

The technical objectives of this project, which is the second of its kind in Algeria, are to increase the stability of the slope of the road, to stiffen its slope, to lighten the soil and finally to avoid the big problem in the region linked to erosion (waste truck tires Michelin 6600). [7]

Photo.4. RN11 project of Mostaganem (Algeria) - Stability of a slope –More great project in Africa.

- **Project of Blida [2008]**

The project is a breakwater made near the Oued Bouarfa, in the wilaya of Blida, with the introduction of 9 layers of tires on a length of 30 m; ground tires are filled with concrete, provided complete coverage of these tires by the tablecloths from all Oued Bouarfa provide double protection (recovery 500 tires).

Photo.5. provision - concreting of the line of tires

• **Project of Miliana [2010]**

The project is well done in the stability of a landslide that was permanent because of the presence of a water source in the valley of Miliana, with the setting up of 5 layers of tires on a linear 25 m, ground tires are deposited on both sides of a 80cm diameter nozzle that discharges water from a source (waste truck tires Michelin 500)

Photo.6. Ply arrangement tire

Photo.7. Repair of the landslide

The various controls and checks the overall stability of the structure, have shown a behavior and stability perfect until now.

4. Conclusion

The idea of recovery of used tires is currently the main priority. In fact the used tire is a waste bulky, but can become very useful; therefore civil engineering has many potential uses of used tires, adding value by building material with novel properties and very useful.

In general, the 'Pneusol' has the advantage, besides the help resorption of old tires from landfills, can improve the mechanical properties of soil. One of the qualities of Pneusol is its flexibility which enables it to withstand large differential settlement. The use of tires as a layer also allows a better distribution of forces in the mass of reinforced soil and the foundations of this essential quality is a very good material Pneusol Civil Engineering, plus a very competitive cost compared than other reinforcement techniques.

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